## SEQUENCE LISTING

<110> Xia, Zhi-Qiang
 Costa, Michael A
 Davin, Laurence B
 Lewis, Norman G

<120> Recombinant Secoisolariciresinol Dehydrogenase, and Methods of Use

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<151> 1998-04-24

<160> 25

<170> PatentIn Ver. 2.0

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1 5 10 15

ctt ata aca gga gga gcc agt gga att gga gaa acc aca gca aaa ctc 96 Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr Thr Ala Lys Leu 20 25 30

ttc tcc caa cat gga gcc áaa gtt gcc att gct gat gtc caa gat gaa 144 Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val Gln Asp Glu 35 40 45

tta ggt cac tca gtt gtc gag gcc att ggc act tcc aat tcc acc tac 192 Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser Asn Ser Thr Tyr 50 55 60

atc cac tgt gat gtt act aat gaa gac ggt gtt aaa aat gcc gtg gac 240 Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn Ala Val Asp

aac aca gtt tca acc tat gga aaa ctg gac att atg ttc agc aat qca Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe Ser Asn Ala gga att tot gat coc aac agg coc cgc atc ata gac aac gaa aaa gca Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp Asn Glu Lys Ala 100 105 gac ttt gaa ege gtt ete agt gta aat gta ace gga gtt tte eta tge 384 Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly Val Phe Leu Cys 115 atg aag cac gca gca cgt gtt atg att cca gca cgc agt ggc aac ata 432 Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg Ser Gly Asn Ile 130 135 att tee act get agt tta age tea act atg ggt ggt tet tea cat 480 Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Ser Ser His 150 155 gcc tat tgt ggt tca aag cat gct gtg tta gcc ctt act agg aat ctg 528 Ala Tyr Cys Gly Ser Lys His Ala Val Leu Ala Leu Thr Arg Asn Leu 165 gca gtc gag ctc gga caa ttt ggc att agg gtt aat tgt ttg tct cct 576 Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys Leu Ser Pro 180 185 ttc ggg ctt cct acg gct tta ggc aag aaa ttt tca ggg att aaa aat 624 Phe Gly Leu Pro Thr Ala Leu Gly Lys Phe Ser Gly Ile Lys Asn 195 200 gaa gaa gaa ttt gag aat gta ata aac ttt gcg gga aat ttg aaa ggt Glu Glu Glu Phe Glu Asn Val Ile Asn Phe Ala Gly Asn Leu Lys Gly 210 215 cca aaa ttt aat gtt gag gat gtt gcc aat gca gct ctt tat ctg gct Pro Lys Phe Asn Val Glu Asp Val Ala Asn Ala Ala Leu Tyr Leu Ala 225 230 agt gat gag gea aaa tac gtg agt gga cac aat ctg ttc att gat gga 768 Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu Phe Ile Asp Gly 245 250 ggg ttc agc gtc tgc aat tct gta atc aaa gtg ttc caa tat cca gat Gly Phe Ser Val Cys Asn Ser Val Ile Lys Val Phe Gln Tyr Pro Asp 260 265 tct 819

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Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val Gln Asp Glu 35 40 45

Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser Asn Ser Thr Tyr 50 55 60

Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn Ala Val Asp 65 70 75 80

Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe Ser Asn Ala 85 90 95

Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp Asn Glu Lys Ala 100 105 110

Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly Val Phe Leu Cys 115 120 125

Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg Ser Gly Asn Ile 130 135 140

Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Gly Ser Ser His 145 150 155 160

Ala Tyr Cys Gly Ser Lys His Ala Val Leu Ala Leu Thr Arg Asn Leu 165 170 175

Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys Leu Ser Pro 180 185 190

Phe Gly Leu Pro Thr Ala Leu Gly Lys Lys Phe Ser Gly Ile Lys Asn 195. 200 205

Glu Glu Glu Phe Glu Asn Val Ile Asn Phe Ala Gly Asn Leu Lys Gly 210 215 220

Pro Lys Phe Asn Val Glu Asp Val Ala Asn Ala Ala Leu Tyr Leu Ala 225 230 235 240

Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu Phe Ile Asp Gly

245 250 255

Gly Phe Ser Val Cys Asn Ser Val Ile Lys Val Phe Gln Tyr Pro Asp 260 265 270

Ser

| C210   |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     |          |
|--|------|-------|--------------|-------|------|---------|---------|---------|------|------|-----|-------|-------|------|------|-----|----------|
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| <pre> &lt;221&gt; CDS &lt;222&gt; (1)(831)  &lt;400&gt; 3     atg gca gcc act tca cag gtt cta act gca atc gca aga agg cta gaa     Met Ala Ala Thr Ser Gln Val Leu Thr Ala Ile Ala Arg Arg Leu Glu     1</pre>  | <21. | 3> F  | orsy         | cnia  | x 1. | ncer    | meaı.   | a       |      |      |     |       |       |      |      |     |          |
| <pre> &lt;221&gt; CDS &lt;222&gt; (1)(831)  &lt;400&gt; 3     atg gca gcc act tca cag gtt cta act gca atc gca aga agg cta gaa     Met Ala Ala Thr Ser Gln Val Leu Thr Ala Ile Ala Arg Arg Leu Glu     1</pre>  |      | ,     |              |       | 7    |         |         |         |      |      |     |       |       |      |      |     |          |
| <pre>&lt;222&gt; (1) . (831)  &lt;400&gt; 3     atg gca gcc act tca cag gtt cta act gca atc gca aga agg cta gaa     Met Ala Ala Thr Ser Gln Val Leu Thr Ala Ile Ala Arg Arg Leu Glu</pre>  |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     |          |
| <pre>&lt;400&gt; 3     atg gca gcc act tca cag gtt cta act gca atc gca aga agg cta gaa Met Ala Ala Thr Ser Gln Val Leu Thr Ala Ile Ala Arg Arg Leu Glu</pre>   |      |       |              |       |      |         |         |         |      |      |     |       | ,     |      |      | •   |          |
| atg gca       gcc act bca       cca cag gtt       cta act gca act gca act gca act gca act gca aga agg cta gaa       48         Met Ala Ala Ala Thr       Ser Gln Val Leu Thr       Ala Ile Ala Ala Ile Ala Arg Arg Leu Glu 15       96         Tyga aaa gtt gcc ctt ala aca gga gga gcc agt gga att gga act gga gaa acc Gly Lys Val Ala Leu Ile Thr Gly 25       Gly Ala Ser Gly Ile Gly Glu Thr 30       96         aca gca aaa ctc ttc tcc caa cat gga gcc aaa gtt gcc att gct gat Thr Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp 35       Gly Ala Lys Val Ala Ile Gly Thr Ser Gln His Gly Ala Lys Val Ala Ile Gly Thr Ser 50       92         gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc act tcc Spt Gln Asn Ser Thr Tyr Ile His Cys Asp 70       Val Glu Ala Ile Gly Thr Ser 60       92         aat tcc acc tac act cac tgt gat gtt act act act gga gcc act tcc Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85       75       80         aat gcc gtg gac act gga att tct gat ccc act agga act gga act act gga act gga act act agga act gga act act agga act gga act act gga act act gga act act agga act gga act act act gga act act gga act act act act gga act act act act act gga act act act gga act act act act act act act act act ac | <22  | 2> (  | 1)           | (831  | )    |         |         |         |      |      |     |       |       |      |      |     |          |
| atg gca       gcc act bca       cca cag gtt       cta act gca act gca act gca act gca act gca aga agg cta gaa       48         Met Ala Ala Ala Thr       Ser Gln Val Leu Thr       Ala Ile Ala Ala Ile Ala Arg Arg Leu Glu 15       96         Tyga aaa gtt gcc ctt ala aca gga gga gcc agt gga att gga act gga gaa acc Gly Lys Val Ala Leu Ile Thr Gly 25       Gly Ala Ser Gly Ile Gly Glu Thr 30       96         aca gca aaa ctc ttc tcc caa cat gga gcc aaa gtt gcc att gct gat Thr Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp 35       Gly Ala Lys Val Ala Ile Gly Thr Ser Gln His Gly Ala Lys Val Ala Ile Gly Thr Ser 50       92         gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc act tcc Spt Gln Asn Ser Thr Tyr Ile His Cys Asp 70       Val Glu Ala Ile Gly Thr Ser 60       92         aat tcc acc tac act cac tgt gat gtt act act act gga gcc act tcc Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85       75       80         aat gcc gtg gac act gga att tct gat ccc act agga act gga act act gga act gga act act agga act gga act act agga act gga act act gga act act gga act act agga act gga act act act gga act act gga act act act act gga act act act act act gga act act act gga act act act act act act act act act ac | •    |       |              |       | -    | -       |         |         | •    |      |     | •     |       |      |      |     |          |
| Met         Ala         Ala         The         Ser         Gln         Val         Leu         Thr         Ala         Ile         Ala         Ala         Arg         Arg         Leu         Glu         15           7gga         aaa         gtt         gcc         ctt         ata         aca         gga         gcc         agt         gga         att         gga         gac         acc         96           Gly         Lys         Val         Ala         Leu         Ile         Thr         Gly         Ala         Ser         Gly         Ile         Gly         Glu         Thr         Ala         Ala         Ile         Ala         Ala         Ile         Ile         Ala         Ala         Ile         Ala         Ala         Ile         Ala         Ala         Ile         Ala         Ile         Ala         Ile         Ala         Ile         Ile         Ala         Ile         Ile         Ala         Ile         Ala         Ile         Ala         Ile         Ala         Ile   | <40  | 0 > 3 |              | •     |      |         |         |         |      |      | *   |       |       |      |      |     |          |
| Met         Ala         Ala         The         Ser         Gln         Val         Leu         Thr         Ala         Ile         Ala         Ala         Arg         Arg         Leu         Glu         15           7gga         aaa         gtt         gcc         ctt         ata         aca         gga         gcc         agt         gga         att         gga         gac         acc         96           Gly         Lys         Val         Ala         Leu         Ile         Thr         Gly         Ala         Ser         Gly         Ile         Gly         Glu         Thr         Ala         Ala         Ile         Ala         Ala         Ile         Ile         Ala         Ala         Ile         Ala         Ala         Ile         Ala         Ala         Ile         Ala         Ile         Ala         Ile         Ala         Ile         Ile         Ala         Ile         Ile         Ala         Ile         Ala         Ile         Ala         Ile         Ala         Ile   | atq  | qca   | qcc          | act   | tca  | caq     | att     | cta     | act  | σca  | atc | qca   | aσa   | agg  | cta  | gaa | 4.8      |
| 96   |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     |          |
| 'gga aaa gtt gcc Ctt ata aca gga gga gcc agt gga att gga gaa acc Gly Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr 20         'gga gaa acc Gly Ile Gly Glu Thr 25         96           aca gca aaa ctc ttc tcc caa cat gga gcc aaa gtt gcc att gct gat Thr Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp 35         144           gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc act tcc Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 50         192           aat tcc acc tac atc cac tgt gat gtt act act aat gaa gac ggt gtt aaa Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65         240           aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg gaa aac gcc gtg gt gtt aaa Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 90         288           ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336         289           ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336         336           po         90         95           ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336         336           po         90         95           ttc agc aat gca gac att tct gat ccc aac agg ccc cgc atc ata gac 336         336           po         90         95   |      |       |              |       |      | <b></b> | • • • • |         |      |      |     | 112.0 | 9     | 9    |      | -   |          |
| Gly Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr 20   |      |       |              |       |      |         | •       |         |      | ΞŪ   |     |       |       |      | 15   | . * |          |
| Gly Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr 20   |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     |          |
| aca       gca       aaa       ctc       ttc       tcc       caa       cat       gga       gcc       aaa       gtt       gcc       att       gct       gat       144         Thr       Ala       Lys       Leu       Phe       Ser       Gln       His       Gly       Ala       Lys       Val       Ala       Ite       Ala       Asp       act       tcc       192         gtc       caa       gat       gat       ggt       cac       tca       gtt       gtc       gag       gcc       att       ggc       act       tcc       192         gtc       caa       gat       gat       ggt       gcc       gat       gcc       att       ggc       act       tcc       192         att       gga       gat       tac       tca       tac       t  |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     | 96       |
| aca gca aaa ctc       ttc tcc caa cat gga gcc aaa gtt gcc att gct gat       144         Thr Ala Lys Leu Phe Ser Gln His Ato       Gly Ala Lys Val Ala Ile Ala Asp 40       145         gtc caa gat gaa tta ggt cac tca ggt gtc gag gcc att ggc act tcc       192         gtc caa gat gaa tta ggt Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 50       192         aat tcc acc tac atc cac tgt gat gtt act aat gaa gac ggt gtt aaa Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65       70         aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85       288         Asn Ala Val Asp Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100       105         aac gaa aac gaa gaa gac gac acc gga 336         Asn Glu Asp Cys Leu Asp Ile Met 85       100         acc acc tat gca acc gac acc gac acc gcc gtt ttc acc acc acc acc acc acc gcc acc acc ac   | GIY  | Lys   | Val          |       | Leu  | Ile     | Thr     | Gly     | Gly  | Ala  | Ser | Gly   | Ile   | Gly  | Glu  | Thr |          |
| Thr         Ala         Lys         Leu         Phe         Ser         Gln         His         Gly         Ala         Lys         Val         Ala         The         Ala         Asp           gtc         caa         gat         tcc         192           gtc         Gln         Asp         Glu         Leu         Gly         His         Ser         Val         Val         Ala         Ile         Gly         Thr         Ser         Ile         Gly         Free         Gly   |      |       |              | 20    | ,    |         |         | •       | 25   |      | •   |       |       | . 30 |      |     |          |
| Thr         Ala         Lys         Leu         Phe         Ser         Gln         His         Gly         Ala         Lys         Val         Ala         The         Ala         Asp           gtc         caa         gat         tcc         192           gtc         Gln         Asp         Glu         Leu         Gly         His         Ser         Val         Val         Ala         Ile         Gly         Thr         Ser         Ile         Gly         Free         Gly   |      |       |              |       |      |         |         |         |      | ·    |     |       |       |      |      |     |          |
| gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc act tcc       192         Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 55       240         aat tcc acc tac atc cac tgt gat gtt act aat gaa gac ggt gtt aaa 240         Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65       70         aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg 288         Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85       90         ttc agc aat gca gaa att tct gat ccc aac agg ccc cgc atc ata gac 336         Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100         aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384         Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115         gtt ttc cta tgc atg atg aag cac gca gca cgt gtt atg att cca gca cgc 432   | aca  | gca   | aaa          | ctc   | ttc  | tcc     | caa     | cat     | gga  | gcc  | aaa | gtt   | gcc   | att  | gct  | gat | 144      |
| gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc act tcc       192         Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 55       240         aat tcc acc tac atc cac tgt gat gtt act aat gaa gac ggt gtt aaa 240         Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65       70         aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg 288         Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85       90         ttc agc aat gca gaa att tct gat ccc aac agg ccc cgc atc ata gac 336         Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100         aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384         Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115         gtt ttc cta tgc atg atg aag cac gca gca cgt gtt atg att cca gca cgc 432   |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     |          |
| gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc act tcc         192           Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 50         240           aat tcc acc tac atc cac tgt gat gtt act aat gaa gac ggt gtt aaa 240           Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65         70           aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg 288           Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85         90           ttc agc aat gca gaa att tct gat ccc aac agg ccc cgc atc ata gac 336           Phe Ser Asn Ala Gly Ile Ser Asp 100         105           aac gaa aaa gca gac ttt gaa cgc gtt ttc agt ttc agt gta aat gta acc gga 384           Asn Glu Lys Ala Asp Phe Glu Arg 120         125           gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca acc gca cgc 432   |      |       |              | •     |      |         |         |         | -    |      | -   |       |       |      |      |     |          |
| Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 50   |      | -     |              |       |      | • •     |         | - 0     |      |      | ٠,  | •     |       |      |      |     |          |
| Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 50   | atc  |       | ast          |       | ++=  | aat     | C 2 C   | + < =   | ~++  | ata  | a=a | ~~~   | a + + | ~~~  | 3.at | +   | 100      |
| aat tcc acc tac atc cac tgt gat gtt act aat gaa gac ggt gtt aaa 240 Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65   | 3701 | Cla   | 200          | Clu   | ton  | 990     | TTdo    | Com     | 9.00 | 9.00 | gag | 33-   | 71-   | ggc  | act. | 2   | 192      |
| aat tcc acc tac atc cac tgt gat gtt act aat gaa gac ggt gtt aaa 240 Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65   | vai  |       | Asp          | GIU   | Leu  | GIY     |         | ser     | val  | vai  | GIU |       | TTE   | GIY  | Thr  | ser |          |
| Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 80  aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg 288 Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85 90 95  ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336 Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100 105 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      | 50    |              |       |      |         | 55      | -       |      |      |     | . 60  |       | ٠.   |      |     | •        |
| Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 80  aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg 288 Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85 90 95  ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336 Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100 105 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      |       |              |       |      |         |         |         |      |      |     |       |       |      | -    | •   |          |
| aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg 288 Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 95  ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336 Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     | 240      |
| aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg 288 Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 95  ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336 Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  | Asn  | Ser   | Thr          | Tyr   | Ile  | His     | Cys     | Asp     | Val  | Thr  | Asn | Glu   | Asp   | Gly  | Val  | Lys |          |
| Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 95  ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336  Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384  Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  | 65   |       | •            |       |      | 70      |         |         |      |      | 75  |       |       |      |      | 80  |          |
| Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 95  ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336  Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384  Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      |       |              |       |      |         |         |         |      |      |     |       |       | -    |      | ٠.  |          |
| Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 95  ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336  Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384  Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  | aat  | gcc   | gtg          | gac   | aac  | aca     | qtt     | tca     | acc  | tat  | qqa | aaa   | cta   | gac  | att  | atq | 288      |
| ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336 Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100 105 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     |          |
| ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac 336  Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100 105 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384  Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      |       |              |       |      |         |         | . – – – |      |      | 1   | 1-    |       |      | 95   |     |          |
| Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100 105 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384  Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432   |      |       |              |       |      |         |         |         | •    |      |     |       |       |      | ,    |     |          |
| Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100 105 110  aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384  Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432   | ++~  | 300   | <del>-</del> | ~~=   | àaa  | a + +   | + a+    | ~ > +   |      |      |     |       |       |      |      |     | 226      |
| aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125 gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     | ,336     |
| aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga 384 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125 gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  | Pne  | ser   | ASI          |       | GTA  | TTE     | ser     | Asp     |      | Asn. | Arg | Pro   | Arg   |      | тте  | Asp |          |
| Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432   |      |       |              | 100   |      |         |         |         | .105 |      |     |       |       | 110  | -    |     |          |
| Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly 115 120 125  gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432   |      |       |              |       | :    | ~       | •       | •       |      |      |     |       |       |      |      |     |          |
| gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  |      |       |              |       |      |         |         |         |      |      |     |       |       |      |      |     | 384      |
| gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432  | Asn  | Glu   | Lys          | Ala   | Asp  | Phe     | Glu     | Arg     | Val  | Phe  | Šer | Val   | Asn   | Val  | Thr  | Gly |          |
| gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432 Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg  |      | ٠     |              |       |      |         |         |         |      |      |     |       |       |      | ,    |     |          |
| gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc 432 Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg  |      |       |              |       |      |         |         |         |      | -    |     | •     |       |      | •    |     |          |
| Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg  | gtt  | ttc   | cta          | tac   | ato  | ааσ     | cac     | qca     | qca  | cat  | att | atσ   | att   | сса  | σса  | cac | 432      |
|  | Val  | Phe   | Leu          | Cys   | Met  | Lys     | His     | Ala     | Ala  | Arq  | Val | Met   | Ile   | Pro  | Ala  | Ara | <u>-</u> |

| 1                       | 30       |             |          |       | 135   |           |           |            |     | 140 |           |           |           |            | •   |
|-------------------------|----------|-------------|----------|-------|-------|-----------|-----------|------------|-----|-----|-----------|-----------|-----------|------------|-----|
| agt g                   |          |             |          | Ser   |       |           | -         |            | Ser |     |           | _         |           | Gly        | 480 |
| 145                     | 5+ · + 6 |             | ~~~      | 150   |       | .~~+      |           | 225        | 155 |     |           |           |           | 160        |     |
| Gly Se                  |          |             |          |       |       |           |           |            |     |     |           |           |           | ctt<br>Leu | 528 |
| act ac                  |          |             |          |       |       |           |           |            |     |     |           |           | _         |            | 576 |
| tgt ti<br>Cys Le        |          | r Pro       |          |       |       |           |           |            |     |     |           |           |           |            | 624 |
| ggg at<br>Gly II        |          |             | _        |       | -     |           |           |            | _   |     |           |           |           |            | 672 |
| aat ct<br>Asn Le<br>225 |          |             |          |       |       |           |           |            | -   | _   | _         |           | -         | -          | 720 |
| ctt ta<br>Leu Ty        |          |             |          |       |       |           |           |            |     |     |           |           |           | _          | 768 |
| ttc at                  |          |             |          |       |       |           |           | Asn        |     |     |           |           |           |            | 816 |
| caa ta<br>Gln Ty        | r Pro    | o Asp       |          | . •   |       |           |           |            |     |     | ٠         | 1         |           |            | 831 |
|                         | 27!      | 5<br>       |          | • •   | ·     |           | · .       |            | •   |     |           |           |           |            | •   |
| <210><211><212>         | 277      |             | -        |       |       | -         |           |            |     |     |           |           |           |            |     |
| <213>                   |          | ythia       | x i      | ntern | nedia | a.        |           | ٠          |     |     |           |           |           | .*         |     |
| <400><br>Met Al         |          | a Thr       | Ser<br>5 | Gln   | Val   | Leu       | Thr       | Ala<br>·10 | Ile | Ala | Arg       | Arg       | Leu<br>15 |            | ,   |
| Gly Ly                  | rs Val   | L Ala<br>20 | Leu      | Ile   | Thr   | Gly       | Gly<br>25 | Ala        | Ser | Gly | Ile       | Gly<br>30 | Glu       | Thr        |     |
| Thr Al                  | a Lys    | _           | Phe      | Ser   | Gln   | His<br>40 | Gly       | Ala        | Lys | Val | Ala<br>45 | Ile       | Ala       | Asp        |     |

Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser 50 55 60

Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys 65 70 75 80

Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85 90 95

Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp 100 105 110

Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly
115 120 125

Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg 130 135 140

Ser Gly Asn Ile Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly 145 150 155 160

Gly Ser Ser His Ala Tyr Cys Gly Ser Lys His Ala Val Leu Gly Leu 165 170 175

Thr Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn 180 185 190

Cys Leu Ser Pro Phe Gly Leu Pro Thr Ala Leu Gly Lys Lys Phe Ser 195 200 205

Gly Ile Lys Asn Glu Glu Glu Phe Glu Asn Val Ile Asn Phe Ala Gly 210 215 220

Asn Leu Lys Gly Pro Lys Phe Asn Val Glu Asp Val Ala Asn Ala Ala 225 230 235 240

Leu Tyr Leu Ala Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu 245 250 255

Phe Ile Asp Gly Gly Phe Ser Val Cys Asn Ser Val Ile Lys Val Phe 260 265 270

Gln Tyr Pro Asp Ser 275

<210> 5

<211> 819

<212> DNA

<213> Forsythia x intermedia

<220>

|   |     |              |            |               |           |          |      |            | •    |            |       |       | •          |      |             |            |       |     |
|---|-----|--------------|------------|---------------|-----------|----------|------|------------|------|------------|-------|-------|------------|------|-------------|------------|-------|-----|
|   |     | 1> C<br>2> ( |            | (819)         | )         |          |      | -          |      |            |       |       |            |      |             |            |       |     |
|   | <22 | 0 >          |            |               |           |          |      |            |      |            |       |       | ٠          |      | ٠           |            |       |     |
|   | <22 | 1> m:        | _          | feati         |           | •        |      |            |      |            |       |       | ,          |      |             |            |       |     |
|   |     |              |            | (819)<br>mole |           | enc      | odin | g se       | cois | olar       | icir  | esin  | ol d       | ehyd | roge        | nase       | where | in  |
|   | •   | Х            | aa =       | any           | ami       | no a     | cid  |            |      | ٠          |       |       |            |      |             |            |       |     |
|   |     | 0 > 5        |            |               |           |          |      |            |      |            | -     |       |            | -    |             |            |       |     |
|   |     |              |            |               |           |          |      |            |      | agg<br>Arg |       |       |            |      |             |            | 48    |     |
|   | 1   |              | Leu        | Arg           | 5         | ALG      | 110  | ALG        | Arg  | 10         | Deu : |       | GLY        | шур  | 15          | AIA        |       |     |
|   |     |              |            |               |           |          |      |            | _    | gga        | _     | -     |            | _    |             |            | 96    |     |
|   | Leu | Ile          | Thr        |               | Gly       | Ala      | Ser  | Gly        |      | Gļy        | Glu   | Val   | Thr        |      | Lys         | Leu        |       |     |
|   |     |              |            | 20            |           |          |      |            | 25   |            |       |       |            | 30   |             |            |       |     |
|   |     |              |            |               |           |          |      |            |      | att        |       |       |            |      |             |            | 144   |     |
|   | Phe | Ser          | GIn<br>35  | His           | Gly       | Ala      | Lys  | Val        | Ala  | Ile        | Ala   | Asp   | Val        | Gln  | Asp         | Glu        |       |     |
|   |     |              |            |               |           | •        |      |            |      |            |       |       |            |      |             |            |       |     |
|   |     |              |            |               |           |          |      |            |      | ggc        |       |       |            |      |             |            | 192   |     |
|   | пеп | 50           | UIS        | ser           | .vaı      | vai      | 55   | Ala        | TTE  | Gly        | PIO   | 60    | ASII       | ser  | Inr         | ıyı        |       |     |
|   |     |              |            |               |           |          |      |            |      |            |       | -     |            |      |             |            |       |     |
|   |     |              |            |               |           |          |      |            |      | ggt<br>Gly |       |       |            |      |             |            | 240   |     |
|   | 65  |              | -1 -       | F             |           | 70       |      |            |      | 1          | 75    | -1-   |            |      |             | 80         | خ     |     |
|   | aac | 202          | art.       | tca           | 300       | tat.     | aa - | 222        | cta  |            | a++   | a t a | ++-a       |      | 22 <b>+</b> | <b>aca</b> | 288   |     |
|   |     |              |            |               |           |          |      |            | _    | Asp        |       | -     |            |      |             | _          | 200   |     |
|   |     |              |            |               | 85        |          | •    | :          | •    | 90         | •     |       |            |      | 95          | •          |       |     |
| • | gga | att          | tct        | gat           | ccc       | tac      | aag  | ccc        | cgg  | gtc        | ata   | gac   | aac        | gaa  | aaa         | gca        | 336   | • . |
|   |     |              |            | Asp           | Pro       |          |      |            | Arg  | Val        |       |       |            | Glu  |             |            | :     |     |
|   |     |              |            | 100           |           | •        |      | •          | 105  |            |       | •     |            | 110  |             | ,          |       |     |
|   |     |              |            |               |           |          |      | _          |      | gtn        |       |       | _          |      |             |            | 384   |     |
|   | Asp | Phe          | Glu<br>115 | Arg           | Val       | Leu      | Ser  | Xaa<br>120 | Asn  | Xaa        | Thr   | Gly   | Val<br>125 | Phe  | Leu         | Phe        |       |     |
|   |     |              | 117        |               |           | ٠.       |      |            |      |            | •     | -     |            | :    |             |            |       |     |
|   |     |              |            |               |           |          |      |            |      | cca        |       |       |            |      |             |            | 432   |     |
|   |     | Lуs<br>-130  | His        | Ala           | Ala       | Arg      | 11e  | Met.       | Val  | Pro        |       | Arg   | Asn        | GTA. | Cys         | IIe        | . ,   |     |
|   |     |              |            | _             |           |          |      |            |      | •          |       |       |            |      |             |            | ,     |     |
|   |     |              |            |               |           |          |      |            |      | atg<br>Met |       |       |            |      |             |            | 480   | 1   |
|   | 145 |              | ****       |               | 201       | 150      | JUL  |            | 1111 |            | 155   | Gry   | -TY        |      | Jer         | 160        |       |     |
|   | ~~- | ·<br>        |            |               | <b></b> - | <u>.</u> |      |            |      |            |       |       |            |      |             |            | 500   |     |
|   |     | -            |            |               |           |          |      | _          | _    | tta<br>Leu |       |       |            |      |             | _          | . 528 |     |
|   |     | - ,          | -          | -             | 165       | -        |      | •          |      | 170        | _     |       |            | _    | 175         |            |       |     |
|   |     |              |            |               |           |          |      |            |      |            |       |       |            |      |             |            |       |     |

|   | _          | _                      |             |           |          |      |           | Gly               |           |           |      |            |           |           |           |       | 576  |
|---|------------|------------------------|-------------|-----------|----------|------|-----------|-------------------|-----------|-----------|------|------------|-----------|-----------|-----------|-------|------|
|   |            |                        |             |           | _        |      |           | gcc<br>Ala<br>200 | _         |           |      |            |           |           | _         |       | 624  |
|   |            |                        |             |           |          |      |           | ata<br>Ile        |           |           |      |            |           |           |           |       | 672  |
| • |            |                        |             |           |          |      |           | gtt<br>Val        |           |           |      |            |           |           |           |       | 720  |
|   |            |                        |             |           |          |      |           | agt<br>Ser        |           |           |      |            |           |           |           |       | 768  |
|   |            |                        |             |           |          |      |           | gca<br>Ala        |           |           |      |            |           |           |           |       | 816  |
|   | tct<br>Ser |                        |             |           |          |      |           |                   |           | ٠         |      |            |           |           |           |       | 819  |
|   | <211       | )> 6<br>L> 21<br>2> PH |             |           |          |      | •         |                   |           |           |      |            |           |           |           | ,     |      |
|   |            |                        |             | hia       | x i      | ıter | nedia     | a .:              |           |           |      |            |           | -         |           |       | -    |
|   | <220       |                        |             | · .       |          |      |           |                   |           |           |      | ٠.         |           |           |           |       |      |
|   | <222       | 2> (2                  | isc_1<br>i) | (273)     | )        |      |           |                   |           |           | •    |            |           |           |           |       |      |
| , | <22        | 3 > S                  | ecoi        | sola      | rici     | resi | nol       | dehy              | drog      | enas      | e wh | erei       | n Xa      | a =       | any       | amino | acid |
|   |            | )> 6<br>Gln            | Leu         | Arg       | Thr<br>5 | Ala  | Ile       | Ala               | Arg       | Arg<br>10 | Leu  | Glu.       | Gly       | Lys       | Val<br>15 | Ala   |      |
| : | Leu        | Ile                    | Thr         | Gly<br>20 |          | Ala  | Ser       | Gly               | Val<br>25 | Gly       | Glu  | Val        | Thr       | Ala<br>30 | Lys       | Leu   |      |
|   | Phe        | Ser                    | Gln<br>35   | His       | Gly      | Ala  | Lys       | Val<br>40         | Ala       | Ile       | Ala  | Asp        | Val<br>45 | Gln       | Asp       | Glu   |      |
| ] | Leu        | Gly<br>50              | His.        | Ser       | Val      | Val  | Glu<br>55 | Ala               | Ile       | Gly       | Pro  | Ser<br>.60 | Asn       | Ser       | Thr       | Tyr   | ÷ ·  |
|   | Ile        | His                    | Cys         | Asp       | Val      | Thr  | Asn       | Glu               | Asp       | Gly       | Val  | Lys        | Asn       | Ala       | Vaļ       | Asp   |      |

65 70 80 Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe Asn Asn Ala Gly Ile Ser Asp Pro Tyr Lys Pro Arg Val Ile Asp Asn Glu Lys Ala 100 105 Asp Phe Glu Arg Val Leu Ser Xaa Asn Xaa Thr Gly Val Phe Leu Phe 120 Met Lys His Ala Ala Arg Ile Met Val Pro Ala Arg Asn Gly Cys Ile 135 Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Ser Ser His Ala Tyr Cys Gly Ala Lys His Ala Val Leu Gly Leu Thr Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys Leu Ser Pro 180 185 Phe Gly Leu Pro Thr Pro Leu Ala Lys Lys Phe Ser Gly Ile Glu Asn Asp Val Asp Phe Ala Asn Ala Ile Glu His Ala Gly Asn Leu Lys Gly 215 Thr Lys Leu Arg Ile Glu Asp Val Ala Asn Ala Ala Leu Phe Leu Ala 230 235 Ser Asp Glu Ala Gln Tyr Val Ser Gly Gln Asn Leu Phe Ile Asp Gly 250 Gly Phe Ser Val Cys Asn Ser Ala Ile Lys Met Phe Gln Tyr Pro Asp 260 265 Ser

<210> 7 <211> 831

<212> DNA

<213> Forsythia x intermedia

<220>

<221> CDS

<222> (1)..(831)

<400> 7

atg gcc agt act tca cag gtt cta act gca atc aca aga agg cta gaa

|   | Met<br>1   | Ala        | Ser        | Thr        | Ser<br>5          | Gln        | Val        | Leu        | Thr        | Ala<br>10         | Ile        | Thr        | Arg        | Arg        | Leu<br>15         | Glu              |     |
|---|------------|------------|------------|------------|-------------------|------------|------------|------------|------------|-------------------|------------|------------|------------|------------|-------------------|------------------|-----|
|   |            |            |            |            |                   |            |            |            |            | gcc<br>Ala        | _          |            |            |            | _                 |                  | 96  |
|   |            |            |            |            |                   |            |            |            |            | gcc<br>Ala        |            |            |            |            |                   |                  | 144 |
|   |            |            |            |            |                   |            |            |            |            | gtc<br>Val        |            |            |            |            |                   |                  | 192 |
|   |            |            |            |            |                   |            |            |            |            |                   |            |            |            |            |                   | aaa<br>Lys<br>80 |     |
|   |            |            |            |            |                   |            |            |            |            | tat<br>Tyr<br>90  |            |            |            |            |                   |                  | 288 |
|   |            |            |            |            |                   |            |            |            |            | aac<br>Asn        |            |            |            |            |                   |                  | 336 |
|   |            |            |            |            |                   |            |            |            |            | ctc<br>Leu        |            |            |            |            |                   |                  | 384 |
| • |            |            |            |            |                   |            |            |            |            | cgc<br>Arg        |            |            |            |            |                   |                  | 432 |
|   |            |            |            |            |                   |            |            |            |            | gta<br>Vaľ        |            |            |            |            |                   |                  | 480 |
|   | gct<br>Ala | gct<br>Ala | tca<br>Ser | cat<br>His | gct<br>Ala<br>165 | tat<br>Tyr | tgt<br>Cys | tgt<br>Cys | tca<br>Ser | aag<br>Lys<br>170 | cat<br>His | gct<br>Ala | gtg<br>Val | tta<br>Leu | ggc<br>Gly<br>175 | ctt<br>Leu       | 528 |
|   |            |            |            |            |                   |            |            |            |            | caa<br>Gln        |            |            |            |            |                   |                  | 576 |
|   |            |            |            |            |                   |            |            |            |            | cct<br>Pro        |            |            |            |            |                   | gta<br>Val       | 624 |
|   | ggg<br>Gly | ctt<br>Leu | gaa<br>Glu | aat<br>Asn | gac<br>Asp        | gaa<br>Glu | gat<br>Asp | ttg<br>Leu | gag<br>Glu | aat<br>Asn        | gca<br>Ala | atg<br>Met | agc<br>Ser | ctt<br>Leu | atg<br>Met        | gga<br>Gly       | 672 |

210 220 aat ctg aaa ggt aca aat ttg aag gct gag gac gtc gcc aat gca qct Asn Leu Lys Gly Thr Asn Leu Lys Ala Glu Asp Val Ala Asn Ala Ala 225 235 ctt tat ctg gca agt gat gag gca aaa tat gtg agt gga cac aat ctg Leu Tyr Leu Ala Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu 245 250 ttc att gat gga ggg ttc agc gtc tac aat tct gca atc aaa atg ttc Phe Ile Asp Gly Gly Phe Ser Val Tyr Asn Ser Ala Ile Lys Met Phe 260 265 caa tat cca gac act 831 Gln Tyr Pro Asp Thr 275 <210> 8 <211> 277 <212> PRT <213> Forsythia x intermedia Met Ala Ser Thr Ser Gln Val Leu Thr Ala Ile Thr Arg Arg Leu Glu 10 Gly Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Phe Thr Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp 35 Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser . 55 Asn Ser Ile Tyr Ile His Cys Asp Val Thr Asn Glu Asp Asp Val Lys 70 . 75 Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met 85 Phe Asn Asn Ala Gly Ile Ala Asp Pro Asn Lys Pro Arg Ile Val Asp 105 Asn Glu Lys Ala Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly 115 120 125 Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Val Pro Ala Arg 135

Ser Gly Ser Ile Ile Ser Thr Ala Ser Val Ser Ser Thr Ile Gly Gly

145 155 150 160 Ala Ala Ser His Ala Tyr Cys Cys Ser Lys His Ala Val Leu Gly Leu 170 Thr Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn 180 185 Cys Leu Ala Pro Tyr Ala Leu Ala Thr Pro Leu Ala Lys Lys Phe Val Gly Leu Glu Asn Asp Glu Asp Leu Glu Asn Ala Met Ser Leu Met Gly 215 220 Asn Leu Lys Gly Thr Asn Leu Lys Ala Glu Asp Val Ala Asn Ala Ala Leu Tyr Leu Ala Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu Phe Ile Asp Gly Gly Phe Ser Val Tyr Asn Ser Ala Ile Lys Met Phe 265 Gln Tyr Pro Asp Thr 275 <210> 9 <211> 828 <212> DNA <213> Forsythia x intermedia <220> <221> CDS -<222> (1)..(828) <400> 9 atg gcc act tca cag ctt cga act gca ttc gca aga agg cta gaa gga Met Ala Thr Ser Gln Leu Arg Thr Ala Phe Ala Arg Arg Leu Glu Gly 10 aaa gtt gcc ctt ata aca gga gga gcc agt gga gtt gga gaa gtc aca Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Val Gly Glu Val Thr 20 gca aaa ctc ttc tcc caa cat gga gcc aaa gtt gcc att gct gat gtc 144 Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val 35 caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc ctt tcc aat Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Leu Ser Asn

|     | acc<br>Thr        |     |     |   |     |   |   |   |   |   | - |   | -   |   |   | 240 |
|-----|-------------------|-----|-----|---|-----|---|---|---|---|---|---|---|-----|---|---|-----|
|     | gtg<br>Val        |     |     |   |     |   |   |   |   |   |   | _ |     | _ |   | 288 |
|     | aat<br>Asn        |     |     |   |     |   |   |   |   |   |   |   |     |   |   | 336 |
|     | aaa<br>Lys        |     |     |   |     |   |   |   |   |   |   |   |     |   | _ | 384 |
|     | cta<br>Leu<br>130 |     |     |   |     |   |   |   |   |   |   |   |     |   |   | 432 |
|     | tgc<br>Cys        |     |     |   |     | _ | _ |   | _ |   |   | _ | ~ ~ |   |   | 480 |
|     | tca<br>Ser        |     |     |   |     |   |   | - |   | _ | _ |   |     |   |   | 528 |
|     | aat<br>Asn        | Leu | _   | _ |     |   |   |   |   |   |   |   | _   |   | - | 576 |
|     | tct<br>Ser        |     |     |   |     |   |   |   |   |   | _ |   |     |   |   | 624 |
|     | gaa<br>Glu<br>210 |     | -   | - | _   | _ |   |   |   |   | _ | - |     |   |   | 672 |
|     | aaa<br>Lys        |     |     |   |     |   |   |   |   |   |   |   |     |   |   | 720 |
|     | ctg<br>Leu        |     |     |   | Glu |   |   |   |   |   |   |   |     |   |   | 768 |
|     | gat<br>Asp        |     |     |   |     |   |   |   |   |   |   |   |     |   |   | 816 |
| tat | cca               | gac | tct | • |     | - |   |   |   |   |   | - |     |   | - | 828 |

Tyr Pro Asp Ser 275

<210> 10

<211> 276

<212> PRT

<213> Forsythia x intermedia

<400> 10

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1 5 10 15

Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Val Gly Glu Val Thr
20 25 30

Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val 35 40 45

Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Leu Ser Asn 50 55 60

Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn 65 70 75 80

Asn Asn Ala Gly Ile Ser Asp Pro Tyr Lys Pro Arg Val Ile Asp Asn 100 105 110

Glu Lys Ala Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly Val
115 120 125

Phe Leu Phe Met Lys His Ala Ala Arg Ile Met Val Pro Ala Arg Ser 130 135 140

Gly Cys Ile Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Gly 145 150 155 160

Ser Ser His Ala Tyr Cys Gly Ser Lys His Ala Val Leu Gly Leu Thr 165 170 175

Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys 180 185 190

Leu Ser Pro Phe Gly Leu Pro Thr Pro Leu Ala Lys Lys Phe Thr Gly
195 200 205

Ile Glu Asn Asp Glu Asp Leu Ala Asn Gly Ile Glu Arg Ala Gly Asn 210 215 220

Leu Lys Gly Thr Lys Leu Arg Ile Glu Asp Val Ala Asn Ala Ala Leu

225 230 235 240

Phe Leu Ala Ser Asp Glu Ala Gln Tyr Val Ser Gly Gln Asn Leu Phe 245 250 255

Ile Asp Gly Gly Phe Ser Val Cys Asn Ser Ala Ile Lys Leu Phe Gln
260 265 270

Tyr Pro Asp Ser 275

<210> 11

<211> 21

<212> PRT

<213> Forsythia x intermedia

<220>

<221> PEPTIDE

<222> (1)..(21)

<223> N-terminal peptide of F. intermedia secoisolariciresinol protein wherein Xaa at positions 3, 12 and 20 represents an unidentified amino acid residue

<400> 11

Gln Val Xaa Thr Ala Ile Ala Arg Asp Leu Glu Xaa Lys Val Ala Leu 1 5 10 15

Ile Thr Gly Xaa Ala 20

<210> 12

<211> 17

<212> PRT

<213> Forsythia x intermedia

<400> 12

Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr Thr Ala 1 5 10 15

Lys

<210> 13

<211> 15

<212> PRT

<213> Forsythia x intermedia

<400> 13

Leu Asn Ile Met Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Lys

1. 10 15 <210> 14 <211> 20 <212> DNA <213> Artificial Sequence <220> <223> Description of Artificial Sequence: oligonucleotide <220> <221> misc\_feature <222> (1)..(20) <223> PCR primer wherein n at positions 3, 9, 15 and 18 represents inosine <400> 14 ggnathggng aracnacngc 20 <210> 15 <211> 20 <212> DNA <213> Artificial Sequence <220> . . <223> Description of Artificial Sequence: oligonucleotide <220> <221> misc\_feature <222> (1)..(20) <223> PCR primer wherein n at positions 3 and 9 represents inosine <400> 15 congorting areacatdat' 20 <210> 16 <211>. 20 <212> DNA <213> Artificial Sequence <223> Description of Artificial Sequence: oligonucleotide <220> <221> misc feature

<222> (1)..(20)

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<223> PCR primer wherein n at positions 3 and 9
       represents inosine
 <400> 16
 congorttnc traacatdat
                                                                     20
 <210> 17
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 <220>
 <223> Description of Artificial Sequence:
       oligonucleotide
. <220>
 <221> misc_feature
 <222> (1)..(20)
 <223> PCR primer
 <400> 17
 attccgctag attgcattga
                                                                     20
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 <213> Artificial Sequence
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 <220>
 <221> misc_feature
 <222> (1)..(20)
 <223> PCR primer wherein n at positions 3 and 9
       represent inosine
 <400> 18
 congorttnc traacatdat
                                                                     20
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<223> Description of Artificial Sequence:
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 <223> T7 PCR primer
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                                                                    20
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 <223> Description of Artificial Sequence:
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 <220>
 <221> misc_feature
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<223> PCR primer
 <400> 20
cagcttcgaa ctgcattcgc aag
                                                                    23
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<211> 22
<212> DNA
<213> Artificial Sequence
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<223> Description of Artificial Sequence:
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<220>
<221> misc_feature
<222> (1)..(22)
<223> T7 PCR primer
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<210> 22
<211> 816
<212> DNA
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<220>
<221> CDS
<222> (1)..(816)
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|----|---------------------|---|-----|-----|-----|-----|-----|---|--|--|-----|
| <4 | 00> 2               | 2 |     |     |     |     |     |   |  |  |     |
| Gl | g ctt<br>n Leu<br>l |   |     |     |     |     |     |   |  |  | 48  |
|    | a aca<br>e Thr      |   |     | Ala |     |     |     |   |  |  | 96  |
|    | c caa<br>r Gln      |   |     |     |     |     |     |   |  |  | 144 |
|    | cac<br>Y His        |   |     |     |     |     |     |   |  |  | 192 |
|    | tgt<br>Cys          |   |     |     |     |     |     |   |  |  | 240 |
|    | a gtt<br>Val        |   |     |     |     |     |     |   |  |  | 288 |
|    | tct<br>Ser          |   |     |     |     |     |     |   |  |  | 336 |
|    | gaa<br>Glu          |   |     |     |     |     |     |   |  |  | 384 |
|    | cac<br>His          |   |     |     | Val | Ile |     |   |  |  | 432 |
|    | act<br>Thr          |   |     |     |     |     | Gly |   |  |  | 480 |
|    | tgt<br>Cys          |   |     |     |     |     |     |   |  |  | 528 |
|    | gag<br>Glu          |   |     |     |     |     |     |   |  |  | 576 |
|    | ctt<br>Leu          |   | Thr |     |     |     |     |   |  |  | 624 |

|            |                |            |            |             |            | ata<br>Ile<br>215 |            |            |           |            |            |            |            |           |            |
|------------|----------------|------------|------------|-------------|------------|-------------------|------------|------------|-----------|------------|------------|------------|------------|-----------|------------|
|            |                |            |            |             |            | gtt<br>Val        |            |            |           |            |            |            |            |           |            |
|            |                |            |            |             |            | agt<br>Ser        |            |            |           |            |            |            |            |           | Gly        |
|            |                |            |            |             |            | gta<br>Val        |            |            |           |            |            |            |            |           |            |
|            | .,             |            |            |             | •          |                   |            | ٠ .        |           |            |            |            |            |           |            |
|            | 0 > 23         |            |            |             |            |                   |            | •          |           |            |            |            |            |           |            |
|            | l> 2'<br>2> PI |            |            |             |            |                   |            |            |           |            |            |            |            |           |            |
|            |                |            | hia        | x in        | iteri      | nedia             | ì          |            |           | •          |            |            | ,          |           |            |
| •          |                |            |            |             |            |                   |            |            |           |            |            |            |            |           |            |
|            | 0 > 20         |            | Th.        | <b>π1</b> – | Dh.        | 77.               |            | 7          | T         | <b>G</b> 3 | <b>G</b> 1 | •          | **- 7      |           | _          |
| 1          | neu            | Arg        | 1111       | A1a<br>5    | Pne        | Ala               | Arg        | Arg        | .10       | GIU.       | GIY        | Lys        | vaı        | 15        | Leu        |
| Tle        | Thr            | Glv        | Glv        | 715         | Ser        | Gly               | Tle        | C1.        | C1.,      | The        | Th~        | 71 -       | 7          | T 011     | Dh o       |
|            | 1111           | Gly        | 20         | Ala         | Set        | GIY               |            | 25<br>25   | GIU       | 1111       | IIII       | Ala        | 30<br>Lys  | Leu       | Pne        |
| Ser        | Gln            | His<br>35  | Gly        | Ala         | Lys        | Val               | Ala<br>40  | Ile        | Ala       | Asp        | Val        | Gln<br>45  | Asp        | Glu       | Leu        |
| Gly        | His<br>50      | Ser        | Val        | Val         | Glu        | Ala<br>55         | Ile        | Gly        | Thr       | Ser        | Asn<br>60  | Ser        | Thr        | Tyr       | Ile        |
| His<br>65  | Cys            | Asp        | Val        | Thr         | Asn<br>70  | Glu               | Asp        | Gly        | Val       | Lys<br>75  | Asn        | Ala        | Val        | Asp       | Asn<br>80  |
| Thr        | Val            | Ser        | Thr        | Tyr<br>85   | Gly        | Lys               | Leu        |            | Ile<br>90 | Met        | Phe        | Ser        | Asn        | Ala<br>95 | Gly        |
| Ile        | Ser            | Asp        | Pro<br>100 | Asn         | Arg        | Pro               | Arg        | Ile<br>105 | Ile       | Asp        | Asn        | Glu        | Lys<br>110 | Ala       | Asp        |
| Phe        | Glu            | Arg<br>115 | Val        | Leu         | Ser        | Val               | Asn<br>120 | Val        | Thr       | Gly        | Val        | Phe<br>125 |            | Cys       | Met        |
| Lys        | His<br>130     | Ala        | Ala        | Arg         | Val        | Met<br>135        |            | Pro        | Ala       | Arg        | Ser<br>140 | Gly        | Asn        | Ile       | Ile        |
| Ser<br>145 | Thr            | Ala        | Ser        | Leu         | Ser<br>150 | Ser               | Thr        | Met        | Gly       | Gly<br>155 | Gly        | Ser        | Ser        | His       | Ala<br>160 |

Tyr Cys Gly Ser Lys His Ala Val Leu Ala Leu Thr Arg Asn Leu Ala 165 Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys Leu Ser Pro Phe Gly Leu Pro Thr Ala Leu Gly Lys Lys Phe Ser Gly Ile Lys Asn Glu 195 200 Glu Glu Phe Glu Asn Val Ile Asn Phe Ala Gly Asn Leu Lys Gly Pro 210 215 Lys Phe Asn Val Glu Asp Val Ala Asn Ala Ala Leu Tyr Leu Ala Ser 230 Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu Phe Ile Asp Gly Gly 245 250 Phe Ser Val Cys Asn Ser Val Ile Lys Val Phe Gln Tyr Pro Asp Ser 265 <210> 24 <211> 33 <212> DNA <213> Artificial Sequence <223> Description of Artificial Sequence: oligonucleotide <220> <221> misc\_feature <222> (1)..(33) <223> PCR primer <400> 24 acatatgcag cttcgaactg cattcgcaag aag 33 <210> 25 <211> '33 <212> DNA <213> Artificial Sequence

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oligonucleotide

<223> Description of Artificial Sequence:

<222> (1)..(33)

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33